Remarks

Claims 1-109 were pending and examined in the Office Action that was mailed October 24, 2006. Claims 110-124 have been cancelled without prejudice in light of the Applicant's restriction requirement election. Claims 1-75 and 80-109 are rejected. Applicant thanks Examiner for indicating allowability of claims 76-79. Claims 1, 76-79, 103 and 104 have been amended. New claims 125 and 126 have been added. Applicant respectfully submits that amendments and additions to the claims are fully supported by the originally-filed specification. Each of the objections and rejections raised in the Office Action is addressed below.

Drawings

Examiner states that the six pages of replacement drawings that were received by the USPTO on June 1, 2004 are unacceptable because they have not been designated "Replacement Sheets." Furthermore, Examiner points out that the text in the drawings need to be replaced by reference numerals and lead lines directed to specific elements of the figures relative to the reference numerals, while descriptive text should appear in the specification with respect to the reference numerals. Applicant submits new Replacement Sheets for Figures 2-5, 7, 9B, 14 and 15 (6 pages) to conform with the Examiner's instructions.

Claim Rejections under 35 USC § 102

Claims 1, 2, 5-20, 26, 30-37, 43-48, 53, 54, 56, 63, 65-75, 80-86, 89-92, and 98-109 have been rejected under 35 U.S.C. § 102(b) as being anticipated by Figures 1-6 of Clough, Jr. et al (U.S. Patent No. 4,029,581).

Clough discloses an apparatus for agitating and aerating sewage and industrial waste within large storage lagoons or bonds. *See, e.g.*, col. 1, lines 54-57. The apparatus of Clough comprises a series of inflatable tubular sections with perforations to allow gas bubbles to escape to aerate the surrounding liquid. This device is placed at the bottom of an large body of liquid such as an open lagoon, pond or moat, i.e., any body of liquid wherein the liquid is unconstrained on at least one side. Agitation takes place primarily at the bottom of the body of liquid, by dispersing bubbles from the device into the liquid for aeration.

The present invention relates to a device for fluid mixing and gas exchange comprising a housing defining an enclosed chamber for holding a liquid (*see, e.g.*, Figs. 2A and 2B), wherein at least one wall of the chamber comprises a plurality of gas-permeable portions, wherein the volume of the enclosed chamber is between approximately 0.5 µl. and approximately 2 ml, and wherein the gas-permeable portions are selectively deflectable into the interior of the chamber. Unlike Clough, the apparatus of the present invention achieves mixing and gas exchange in chambers have *small, enclosed* volumes. Furthermore, mixing and gas exchange occur due to the chamber of various embodiments comprising one or more walls including selectively deflectable portions. The deflectable portions are deflected in a sequence that results in peristaltic action that mixes and oxygenates the contents *inside* the chamber, e.g., for culturing cells such as bacteria. Oxygen transfer occurs by molecular diffusion through the gas-permeable portions, not by gas passage through perforations which result in gas bubbles as is disclosed by Clough.

Claims 2, 5-20, 26, 30-37, 43-48, 53, 54, 56, 63, 65-75, 80-86, 89-92, 98-102, 105-109 all depend from independent claim 1. Claims 103 and 104 have been amended to further define that which the Applicant claims. Applicant respectfully submits that Clough does not disclose, teach or suggest all of the elements of the presently claimed invention. Therefore, Applicant respectfully requests that these rejections be reconsidered and withdrawn.

Claims 1, 2, 5-13, 16, 17, 20, 26, 30, 32-34, 36, 37, 40-48, 53, 54, 56, 60, 63-65, 67, 68, 70, 71, 80-83, 89, 92, 98, 99, and 105-109 have been rejected under 35 U.S.C. § 102(b) as being anticipated by Figures 1-4 of Gruber (U.S. Patent No. 4,793,714).

Gruber discloses an apparatus that intersperses a gas within a liquid by mechanically vibrating a perforated membrane that separates the gas and liquid. The vibrations cause "fine" gas bubbles to form. The mechanical vibration of the device allows these small gas bubbles to release through the perforations in the membrane, and into the liquid. The method of mixing liquid as disclosed by Gruber requires the buoyant rise of the dispersed gas bubbles through the liquid (e.g., Figs. 1-4).

As stated above, the present invention relates to a device for fluid mixing and gas exchange comprising a housing defining a small, enclosed chamber for holding a liquid,

wherein at least one wall of the chamber comprises a plurality of gas-permeable portions, and wherein the gas-permeable portions are selectively deflectable into the interior of the chamber. The apparatus of the present invention achieves mixing and gas exchange in chambers by deflecting the gas-permeable portions in a sequence that results in peristaltic action that mixes and oxygenates the contents inside the chamber. Since oxygen transfer occurs by molecular diffusion, the devices of the present invention do not form gas bubbles.

Gruber does not disclose, teach or suggest the present invention as claimed, and specifically wherein at least one wall of the chamber comprises a plurality of gas-permeable portions that are selectively deflectable into the interior of the chamber. Claims 2, 5-13, 16, 17, 20, 26, 30, 32-34, 36, 37, 40-48, 53, 54, 56, 60, 63-65, 67, 68, 70, 71, 80-83, 89, 92, 98, 99, and 105-109 depend from independent claim 1. Therefore, Applicant respectfully requests that these rejections be reconsidered and withdrawn.

Claim Rejections under 35 USC § 103

Claims 1-18, 20-71, 80, 86-99 and 103-109 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over Halberstadt et al.

Examiner states that "Halberstadt (abstract; Figs. 1 and 4, col. 5, lines 17-23, 40; col. 6, lines 21-42; col. 7, lines 16-17, 28-30, 58-65; col. 8, lines 1-8, 29-33) substantially disclose Applicant's invention as recited by instant claims 1-18, 20-71, 80, 86-99, and 103-109, except for the deflectable gas-permeable portions being specifically formed as a wall of a liquid chamber, the volume of the chamber and area of the portions being as set forth by instant claims 20-25, and 27-29, respectively." The Examiner continues that "[t]he reference is also silent as to the deflection frequency and the diffusivity, solubility, or permeability of the portions." Applicant agrees.

The device disclosed in Halberstadt comprises two fluid-permeable tubes which are wound or woven to fill almost the entire interstitial space of a spool or other fluid-tight enclosure. The Halberstadt device further comprises a third, gas-permeable tube that can be wound or woven with the other two fluid-permeable tubes. Halberstadt discloses supplying gas from the gas-permeable tube to the surrounding liquid. The flow rate of both gas and fluid tubes are controlled by a peristaltic pump. Aeration is

accomplished through passive diffusion and mixing is accomplished by fluid-driven convection.

Halberstadt does not teach, disclose or suggest a device for fluid mixing and gas exchange as claimed by the present invention, comprising a housing defining a small, enclosed chamber for holding a liquid, wherein at least one wall of the chamber comprises a plurality of gas-permeable portions, and wherein the gas-permeable portions are selectively deflectable into the interior of the chamber. Unlike Halberstadt, the apparatus of the present invention achieves mixing and gas exchange in chambers by deflecting the gas-permeable portions in a sequence that results in peristaltic action that mixes and oxygenates the contents inside the chamber. Halberstadt does not disclose, teach or suggest any mechanical change (e.g., a portion of an enclosed chamber selectively deflectable into the interior of the chamber) within its device.

Claims 2-18, 20-71, 80, 86-99 and 105-109 depend from independent claim 1. Claims 103 and 104 have been amended to further define that which the Applicant claims. Applicant respectfully submits that Halberstadt does not disclose, teach or suggest all of the elements of the presently claimed invention. Therefore, Applicant respectfully requests that these rejections be reconsidered and withdrawn.

Based on the above, Applicant respectfully requests that the Examiner reconsider and withdraw all outstanding rejections and objections. Favorable consideration and allowance are earnestly solicited. Should there by any questions after reviewing this paper, the Examiner is invited to contact the undersigned at 617-248-4054.

Please charge any fees as may be required, or credit any overpayments, to our Deposit Account No. 03-1721.

Respectfully submitted,

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